

Claims

What we claim is:

1. A purified nucleic acid segment comprising a coding region encoding enzymatically active hyaluronate synthase.
2. The purified nucleic acid segment of claim 1, wherein the purified nucleic acid segment encodes the *Streptococcus equisimilis* hyaluronate synthase of SEQ ID NO:2.
3. The purified nucleic acid segment of claim 1, wherein the purified nucleic acid segment comprises a nucleotide sequence in accordance with SEQ ID NO:1. *Q*
4. A purified nucleic acid segment having a coding region encoding enzymatically active hyaluronate synthase, wherein the purified nucleic acid segment is capable of hybridizing to the nucleotide sequence of SEQ ID NO:1.
5. A purified nucleic acid segment having a coding region encoding enzymatically active hyaluronate synthase, wherein the purified nucleic acid segment has semiconservative or conservative amino codon acid changes when compared to the nucleotide sequence of SEQ ID NO:1.
6. A recombinant vector selected from the group consisting of a plasmid, cosmid, phage, or virus vector and wherein the

recombinant vector further comprises a purified nucleic acid segment having a coding region encoding enzymatically active hyaluronan synthase.

7. The recombinant vector of claim 5, wherein the purified nucleic acid segment encodes the *Streptococcus equisimilis* hyaluronan synthase of SEQ ID NO:2.

8. The recombinant vector of claim 6, wherein the purified nucleic acid segment comprises a nucleotide sequence in accordance with SEQ ID NO:1.

9. The recombinant vector of claim 6, wherein the plasmid further comprises an expression vector.

10. The recombinant vector of claim 9, wherein the expression vector comprises a promoter operatively linked to the enzymatically active *Streptococcus equisimilis* hyaluronan synthase coding region.

11. A recombinant host cell, wherein the recombinant host cell is a prokaryotic cell transformed with a recombinant vector comprising a purified nucleic acid segment having a coding region encoding enzymatically active hyaluronan synthase.

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12. The recombinant host cell of claim 11, wherein the purified nucleic acid segment encodes the *Streptococcus equisimilis* hyaluronan synthase of SEQ ID NO:2.

13. The recombinant host cell of claim 11, wherein the purified nucleic acid segment comprises a nucleotide sequence in accordance with SEQ ID NO:1.

14. The recombinant host cell of claim 13, wherein the host cell produces hyaluronic acid.

15. The recombinant host cell of claim 11, wherein the enzymatically active hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified structure.

16. The recombinant host cell of claim 11, wherein the enzymatically active hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified size distribution.

17. A recombinant host cell, wherein the recombinant host cell is a eukaryotic cell transfected with a recombinant vector comprising a purified nucleic acid segment having a coding region encoding enzymatically active hyaluronan synthase.

18. The recombinant host cell of claim 17, wherein the purified nucleic acid segment encodes the *Streptococcus equisimilis* hyaluronan synthase of SEQ ID NO:2.

19. The recombinant host cell of claim 17, wherein the purified nucleic acid segment comprises a nucleotide sequence in accordance with SEQ ID NO:1.

20. The recombinant host cell of claim 19, wherein the host cell produces hyaluronic acid.

21. The recombinant host cell of claim 17, wherein the enzymatically active hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified structure.

22. The recombinant host cell of claim 17, wherein the enzymatically active hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified size distribution.

23. A recombinant host cell, wherein the recombinant host cell is electroporated to introduce a recombinant vector into the recombinant host cell, wherein the recombinant vector comprises a purified nucleic acid segment having a coding region encoding enzymatically active hyaluronan synthase.

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24. The recombinant host cell of claim 23, wherein the purified nucleic acid segment encodes the *Streptococcus equisimilis* hyaluronan synthase of SEQ ID NO:2.

25. The recombinant host cell of claim 23, wherein the purified nucleic acid segment comprises a nucleotide sequence in accordance with SEQ ID NO:1.

26. The recombinant host cell of claim 25, wherein the host cell produces hyaluronic acid.

27. The recombinant host cell of claim 23, wherein the enzymatically active hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified structure.

28. The recombinant host cell of claim 23, wherein the enzymatically active *Streptococcus equisimilis* hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified size distribution.

29. A recombinant host cell, wherein the recombinant host cell is transduced with a recombinant vector comprising a purified nucleic acid segment having a coding region encoding enzymatically active *Streptococcus equisimilis* hyaluronan synthase.

30. The recombinant host cell of claim 29, wherein the purified nucleic acid segment encodes the *Streptococcus equisimilis* hyaluronan synthase of SEQ ID NO:2.

31. The recombinant host cell of claim 29, wherein the purified nucleic acid segment comprises a nucleotide sequence in accordance with SEQ ID NO:1.

32. The recombinant host cell of claim 31, wherein the host cell produces hyaluronic acid.

33. The recombinant host cell of claim 29, wherein the enzymatically active hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified structure.

34. The recombinant host cell of claim 29, wherein the enzymatically active hyaluronan synthase is capable of producing a hyaluronic acid polymer having a modified size distribution.

35. A purified composition, wherein the purified composition comprises an enzymatically active hyaluronan synthase polypeptide.

36. A purified composition, wherein the purified composition comprises a polypeptide having an amino acid sequence in accordance with SEQ ID NO:2.

39. A method for producing hyaluronic acid, comprising the steps of:

introducing a purified nucleic acid segment having a coding region encoding enzymatically active hyaluronan synthase into a host organism, wherein the host organism contains nucleic acid segments encoding enzymes which produce UDP-GlcNAc and UDP-GlcA;

growing the host organism in a medium to secrete hyaluronic acid; and

recovering the secreted hyaluronic acid.

40. The method according to claim 39, wherein the step of recovering the hyaluronic acid comprises extracting the secreted hyaluronic acid from the medium.

41. The method according to claim 40, further comprising the step of purifying the extracted hyaluronic acid.

42. The method according to claim 39, wherein in the step of growing the host organism, the host organism secretes a structurally modified hyaluronic acid.

43. The method according to claim 39, wherein in the step of growing the host organism, the host organism secretes a hyaluronic acid having a modified size.

44. A pharmaceutical composition comprising a preselected pharmaceutical drug and an effective amount of hyaluronic acid produced by hyaluronan synthase.

45. The pharmaceutical composition of claim 44, wherein the hyaluronic acid is produced by the *Streptococcus equisimilis* hyaluronan synthase of SEQ ID NO:2.

46. The pharmaceutical composition according to claim 44, wherein the molecular weight of the hyaluronic acid is modified thereby producing a modified molecular weight pharmaceutical composition capable of evading an immune response.

47. The pharmaceutical composition according to claim 44, wherein the molecular weight of the hyaluronic acid is modified thereby producing a modified molecular weight pharmaceutical composition capable of targeting a specific tissue or cell type within the patient having an affinity for the modified molecular weight pharmaceutical composition.

48. A purified and isolated nucleic acid sequence encoding enzymatically active hyaluronan synthase, the nucleic acid sequence selected from the group consisting of:

- (a) the nucleic acid sequence in accordance with SEQ ID NO:1;
- (b) complementary nucleic acid sequences to the nucleic acid sequence in accordance with SEQ ID NO:1;

- (c) nucleic acid sequences which will hybridize to the nucleic acid in accordance with SEQ ID NO:1;
- (d) nucleic acid sequences which will hybridize to the complementary nucleic acid sequences of SEQ ID NO:1; and
- (e) nucleic acid sequences which will hybridize to PCR probes selected from the group consisting of PCR probes of SEQ ID NO:3, SEQ ID NO:4, SEQ ID NO:5, SEQ ID NO:6.

49. A purified and isolated nucleic acid segment consisting essentially of a nucleic acid segment encoding enzymatically active hyaluronan synthase.

50. A procaryotic or eucaryotic host cell transformed or transfected with an isolated nucleic acid segment according to claim 1, 2, or 3 in a manner allowing the host cell to express hyaluronic acid.

51. An isolated nucleic acid segment consisting essentially of a nucleic acid segment encoding hyaluronan synthase having a nucleic acid segment sufficiently duplicative of the nucleic acid segment in accordance of SEQ ID NO:1 to allow possession of the biological property of encoding for *Streptococcus equisimilis* hyaluronan synthase.

52. A cDNA sequence according to claim 51.

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(B) the nucleotide sequence in accordance with SEQ ID NO: 1;

(C) nucleic acid segments which hybridize to the nucleic acid segments defined in (A) or (B) or fragments thereof; and

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(D) nucleic acid segments which but for the degeneracy of the genetic code, or encoding of functionally equivalent amino acids, would hybridize to the nucleic acid segments defined in (A), (B), and (C).

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